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The Green Revolution and Food Insecurity in India

When most think of wheat farms, their minds may imagine sprawling fields of tall wheat stalks with heads full of grain. This was not always the case. Before the Green Revolution, wheat yields were miniscule. This changed after Norman Borlaug created the wheat variety commonly seen today. India turned to this newest agricultural technology in an attempt to eradicate food insecurity, but the government set in motion policies that would cause repercussions for decades to come. Nutrient deficiency has become a by-product of the Indian government's past funding and subsidies of staple grain farming. Today, the problem is transitioning from a lack of calories to a lack of nutrients. Through the use of the newest technology and food system reconfiguration, India may have a fighting chance to stop this problem before it becomes even worse.

India is a young country that was thrown into the global arena after years of social and political unrest. India became the largest democracy after it successfully gained independence from Britain in the summer of 1947 ("India", 2020). Shortly after becoming an independent democracy, India encountered a new problem: hunger. India was not producing enough food to support its large, growing population. According to Mahyco Grow (2015), in 1966, India was forced to import 10 million tons of wheat from other nations. India was now fighting a battle not for independence but for self-reliance. Luckily for them, a young farmer was about to make a groundbreaking discovery. In the mid-1960s, Norman Borlaug and his team arrived in Mexico to help wheat farmers struggling with small yields and diseases that hindered their crops. Through the use of plant breeding, Borlaug's team created a disease-resistant and high-yielding wheat variety in three years (Pingali, 2012). This new breed began the Green Revolution that changed the landscape of world hunger. Using Borlaug's new breed, India was able to grow large quantities of wheat to feed its growing population. The hunger situation in India has progressively improved over the past few decades; however, the facts still remain bleak.

According to a report by the Tata-Cornell Institute for Agriculture and Nutrition (2020), in the early 1990s, approximately 210 million men, women, and children went undernourished. Over the past three decades, that number has only decreased by a mere 7 percent. However, in recent publishings (Schmall & Singh, 2021), investigators have found that some regions in India produce too much wheat and rice given the population size because of government subsidies. This leads to the Indian government attempting to ship these large quantities of surplus staple grains across the country. Unfortunately, these efforts are in vain because of poor infrastructure. In turn, surplus food goes bad or rots prior to it reaching its final destination. The most unsettling aspect of hunger in India is the increased prevalence of child malnutrition. Malnourished children tend to develop life-threatening health problems earlier in life. These problems include illnesses like colon cancer, Crohn's disease, and celiac disease (Olsen, n.d.). A 2016 report by the Tata-Cornell Institute for Agriculture and Nutrition found that 35% of Indian children were underweight (Tata-Cornell, 2020). To put that number into perspective, about 3-5% of American children are underweight (Fryer & Ogden, 2015). The innovations of Norman Borlaug have done a great deal to decrease the number of hungry citizens over the past few decades, but a new problem is emerging in the wake of undernourishment. Due to the increase in nutrient-lacking cereal production during the Green Revolution, other necessary foods like fruits and vegetables took a back seat as the Indian government used new policies and funding to transition farmers to the newly altered crop (Johari, 2020). Even today, these outdated policies are still hindering farmers to produce nutrient dense foods. The Indian government sets wheat prices to make it profitable for farmers to grow varieties of wheat but some grain staples that are more nutritious like basmati rice, are not subsidized. This leads farmers to grow subsidized crops that

turn the most profit. Thus, when a citizen goes to the market, they do not find the most nutritious foods, but the most heavily subsidised. In turn, hunger is slowly decreasing but health problems related to a lack of key nutrients are on the rise. Nutrient deficiency will be the next health crisis in India.

Citizens are not purposefully avoiding healthy foods. Indians are indirectly disincentivized to purchase nutrient dense foods due to a plethora of factors. The largest factor is the availability of calorie dense foods at mandis. Mandis are government sponsored or operated markets that serve as a meeting place for buyers and sellers of produce (Schmall & Singh, 2021). These markets tend to be filled with farmers selling crops that have been subsidized by the Indian government. Because of India's past funding to farms that grew foods like wheat and rice, the prevalence of those foods dwarf that of the nutrient dense foods. The availability of cereals has grown tremendously over the past 50 years. It should be noted that positive impacts on the access to some healthy foods have grown but not nearly as much as the access to staple grains. For example, the availability of calcium rich milk has also increased over that same time period, according to a study by the Tata-Cornell Institute for Agriculture and Nutrition (2020). Unfortunately, successes like these are far and few between. The prevalence of protein rich foods like meat, eggs, and fish has stayed stagnant. This stagnation can be attributed to little wealth among farmers to start new ventures as well as a lack of subsidies for those proteins. Protein is a vital macronutrient that helps humans build and maintain muscle. This lack of supply has caused increased rates in obesity and other long-term health concerns that stem from malnourishment.

Many Americans take for granted the opportunity to purchase reasonably priced, healthy vegetables at their local grocery store. This is not the case for many Indians who have to decide between unsubsidised, expensive vegetables or subsidised staple grains that are much more affordable. A huge increase in the price of fruits and vegetables has made the situation worse. This rise in the price of healthy foods like potatoes and onions is due to lack of supply and in some cases, inclement weather conditions (Johari, 2020). The Indian government has made it a priority to have backup supplies of cereals and wheat but not fruits and vegetables. With all of these factors at play, Indians are forced to choose calorie dense options, like cereals, over nutrient dense foods like fruits in order to save money. That decision costs them important micronutrients and vitamins. Nutrient deficiency starts at a young age when children eat calorie dense foods to meet their daily intake goals while sacrificing nutrients in the process. According to a report by Kotecha (2008), more than 6,000 children below the age of five die in India every day. More than half of these deaths are caused by malnutrition - mainly the lack of Vitamin A, iron, iodine, zinc and folic acid. If a child makes it through adolescence and into adulthood, health concerns may arise due to decades of malnourishment. For example, a lack of iron in a person's diet can lead to anemia (Olsen, n.d.) Foods like red meat and eggs have a high iron content, but they are far and few between in India. Vitamin A is also found in foods not available to most Indians like carrots, peaches, and tomatoes. This vitamin plays an important role in the immune system and can support a healthy infancy. Healthy foods are a must for all humans and lead to a fruitful and fulfilling life. The Indian government needs to shift their focus from staple grains to nutrient-rich foods if they are to better the health of their people through better nourishment.

Eating healthy foods rich with vitamins and nutrients can greatly alter the life of an individual. Diseases like obesity, anemia, and osteoporosis could plague the population in both rural and urban areas where nutrient dense foods are not available. Malnutrition can also be linked to negative effects in brain developments and even learning abilities. These individual side effects can eventually be detrimental to the economic development of a community. The worst effects will be in underdeveloped, rural communities that depend on government funding and outreach for their daily caloric intake. This is due to a heavy emphasis on staple grains within government-run food subsidies and programs. Multiple paths to eradicating nutrient deficiencies exist, but the most efficient will be a conglomeration of both increased public funding and better access to healthy, vitamin dense foods. The Indian government uses a variety of some of the largest food assistance programs in the world to feed its hungry population. India is set to

make these massive programs even bigger with budgets nearing 1.2 trillion rupees or close to 16 billion USD. These programs include the Child Development Scheme, Mid-Day Meal Scheme, and the Public Distribution System (PDS). All of the above programs have led the way to eradicating hunger, but they mostly focus on one group of foods: staple grains. According to a report by George & McKay (2019), India spends close to 10 billion USD on the PDS program every year. Those who rely solely on the PDS are forced to consume a diet limited in diverse, nutrient dense foods. To fix this problem, the Indian government should focus more on the distribution of nutritious foods like leafy greens or at least more nutritious staple grains. In this way, those that are aided by the Indian food welfare system can enjoy healthier diets. The reconfiguration of the current food system is necessary to help improve the livelihoods of those who rely on the government food programs for their daily caloric needs.

Subsidies of staple grains have long incentivized the large agricultural workforce in India to produce only staple grains. These policies make it more profitable for farmers to grow subsidized foods, especially staple grains like wheat and rice, for a number of reasons. In some cases, the government will offer reduced prices on seeds, farm equipment, or even buy farmers' crops and sell them for less than they bought them for. New policies or even the removal of outdated, detrimental policies can incentivize farmers to grow more fruits and vegetables as well as raise livestock for meat and dairy products in certain regions. Even if the government doesn't step in and set regulated prices for these new, healthier foods, citizens will pay a premium for nutritious foods until supply meets the demand. The subsidies have run their course and it is now time to look towards different means of incentivising food production in India. With that being said, some subsidies for staple grains can continue because of the sheer size of India's agricultural workforce. According to a study published by Aaron O'Neill in 2021, for the past decade, 50% of workers in India are agricultural laborers. That's nearly 500 million people! Even if five percent of those workers switched to cultivating fruits and vegetables, 2.5 million workers would be growing nutritious foods. However, this shift shouldn't happen rapidly. As seen in recent months, many farmers find it difficult to shift from one crop to the other, especially if their families have been cultivating a single crop for generations. It is quite evident that the need and willingness for nutrient dense food as millions go without necessary vitamins everyday. The citizens of India are hungry for a new solution and tinkering with the current subsidies could be that solution.

There have been great leaps worldwide to improve agriculture and healthy eating. India can use a recent advancement in science and technology to artificially make crops more nutritious. This process is known as biofortification, which is defined as when the "nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology" (WHO, 2019). Biofortification can help add necessary nutrients and vitamins to the grains already distributed by government organizations that the Indian government spends billions of dollars on. It is the same process Norman Bourlag used to start the Green Revolution. Iron, vitamin A, and zinc can all be added to the diets of impoverished Indians through the addition of these key nutrients into staple grains. Biofortification also poses little risk to the individuals that consume fortified foods. A downside to biofortified foods is the change in cultivation. Some biofortified foods require more water or fertilizer in order to grow them. Health issues like anemia can be greatly reduced without a complete and rapid reconstruction of the Indian food system, but with the fortification of plant seeds. While this technology is new and additional research and development is needed to implement the biofortification of crops, adaptation will be swift and simple because the biofortification process does not alter the way the grains are planted or harvested. These modern-day revelations could pioneer a new future for India and its people.

India is currently trying to eradicate widespread hunger and undernutrition by producing large amounts of staple grains, causing a large void of nutrients in the diets of citizens. With this shift, millions of Indians lack key nutrients necessary to support a healthy immune system and heart. Thus, less individuals are suffering from hunger, but more are suffering from malnutrition. Using subtle, yet impactful changes to the subsidies, programs, and agricultural technology India has already put in place, it can greatly improve its food situation. To reverse the negative effects of the Green Revolution-era subsidies, India must implement policies that refocus on the cultivation of fruits and vegetables. Though hunger is still a major issue in India, malnutrition could cause a food catastrophe in the coming years.

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